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HASHIMOTO

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**Processing material in progressive die - using laser processor able to move in both feed and transverse directions, press machine and progressive die (Eng)**

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94.01.14 94EP-300261 R(DE FR GB)

In front of a press machine (1) with a progressive die (3) is a laser processor (12) with material (9) to be processed fed at a steady rate through the progressive die.

The head of the laser processor can be moved in at least two directions including the material feed direction and a transverse direction to execute accompanying processes such as a forward end cutting (A) or to make dummy holes (15) in the material being processed.

ADVANTAGE - Performs operation without unwanted deformation of material which can be fed steadily into progressive die. (9pp Dwg.No.2/3)

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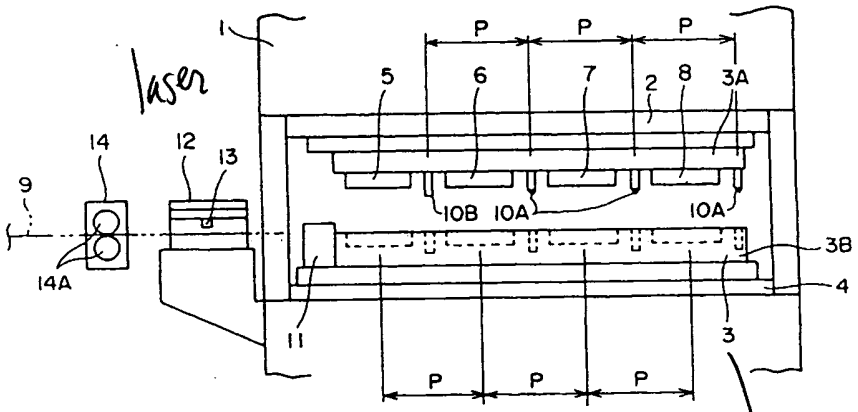


laser

col 4
program control

forming die



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## (54) Method and apparatus for processing material in a progressive die.

(57) A laser process machine 12 is disposed in front of a progressive die 3 in a press machine 1 in the feeding direction of material 9 to be processed. The head 13 of the laser process machine 12 is adapted to move at least in two directions such as the feeding direction and the transverse direction of the material to execute the accompanying processes such as a forward end cutting off process A or a process of making dummy holes 15 in the material to be processed 9. The accompanying process can be performed without unwanted deformation of the material 9 allowing the material 9 to be fed into the progressive die 3 steadily.

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This invention relates to a method of processing a material to be processed by a press machine provided therein with a progressive die, and an apparatus for the processing.

In known processes, material to be processed is fed from an uncoiler and processed by a progressive die of a press machine. This process is supplemented by various kinds of accompanied processes, for example, joining the material to be processed with new material to be processed so that the material is contiguously fed to the press machine.

An accompanied process, is described in Japanese Patent Laid-open No. HEI 4-94828. While a forward end of the material to be processed is fed to a pull-roll feeding apparatus disposed at the releasing side of the press machine, dummy holes which are bigger than processing portions for a phased processing of the progressive die are punched out in the material to be processed at equal pitch on the front side of the progressive die along a feeding direction of the material to be processed. Thus the material to be processed is not processed at the respective processing portions during the phased processing. Therefore, it will not be necessary for a person engaged in the progressive process to transfer the forward end of the material to be processed manually until the forward end thereof reaches the pull-roll feeding apparatus.

Furthermore, other accompanied processes include a forward end cutting process for cutting the forward end of the material to be processed to obtain a fine-finished forward end of the material to be processed, a forward end tapered-off process for cutting off both corner portions of the forward end to feed the forward end smoothly into the progressive die, and a process for making pilot relief holes to position the material to be processed by corresponding pilot pins in the main process by the progressive die. In addition, there is also provided a cutting process for cutting the material to be processed after the designated numbers of the pressed products are obtained by the main process with the progressive die.

In Japanese Patent Application Laid-open No. HEI 4-94828 as mentioned above, a so-called dummy die is provided in front of the progressive die in the feeding direction of the material to be processed to punch out the dummy holes in the material to be processed. In this case, the process of punching the material to be processed causes deformation such as warpage and dimensional disorder of the pitch when making pilot relief holes in the material to be processed, so that the material to be processed cannot be fed into the progressive die steadily.

Accordingly, in the accompanied processes besides the main process, when the main process is performed in the material to be processed by the progressive die, it is desirable that the material to be processed is fed into the progressive die smoothly without any deformation of the material to be processed.

According to a first aspect of the present invention, a method of processing a material comprises a main process step of progressive processing of a material which is progressively fed through a press machine using a progressive die which is provided in the press machine; and an accompanied process step for processing the material by a laser process machine which is arranged in front of the progressive die in the feeding direction of the material.

Preferably the accompanied process step includes at least one process among a process for cutting a forward end of the material, a process for cutting off both corner portions of the forward end of the material, a process for making a pilot relief hole in the material, and a process for making in the material a dummy hole the dimensions of which are bigger than each processing portion provided in the progressive die, which are performed before the main process step; and a process for cutting the material and a process for joining the material to a new supply of material, which are performed after the main process step.

Preferably the accompanied process step is to make in the material a dummy hole, the dimensions of which are bigger than each processing portion provided in the progressive die at a position remote from the first processing portion by an integer times the pitch defined between adjacent processing portions provided at equal pitch in the progressive die along the feeding direction of the material.

Preferably the accompanied process step is to make pilot relief holes in the material at a position remote from a punch making pilot relief holes, at a portion where the material to be processed is fed into the progressive die, by an integer times the pitch defined between pilot pins and the punch provided at equal pitch in the progressive die along the feeding direction of the material.

The material to be processed may be fed by a feeding means including a pull-roll feeding apparatus arranged at the releasing side of the material to be processed through the progressive die. In this case, when the process of forming a dummy hole is performed, the interval between the position where the first dummy hole is made and the forward end of the material to be processed is equal to the interval between the last processing portion of the processing portions provided at equal pitch in the progressive die along the feeding direction of

the material to be processed and the pull-roll feeding apparatus, adding the grip margin for gripping the material to be processed by the pull-roll feeding apparatus.

According to a second aspect of the present invention an apparatus for progressively processing a material, comprises a press machine having a progressive die for processing material which is fed into the press machine; a laser process machine which is disposed in front of the progressive die in the feeding direction of the material, the laser process machine being provided with a head for irradiating a laser beam which processes the material, the head being adapted to move at least in two directions.

Preferably a drive device for moving the head in the two directions contains a control mechanism having a program for controlling the head.

Preferably the head is adapted to move in the feeding direction of the material and in a transverse direction.

A push-roll feeding apparatus for moving the material to be processed by a pair of rollers is preferably provided in front of the laser process machine in the feeding direction of the material to be processed. A pull-roll feeding apparatus for moving the material to be processed by a pair of rollers is preferably provided at the releasing side of the material to be processed in the progressive die.

In the present invention, the material to be processed is processed by the above-mentioned laser process machine, so that deformation such as warping is not caused in the material to be processed. A disadvantage such as disorder of the pitch between the dummy holes or between the pilot relief holes which are made in the material to be processed is avoided because the pitch therebetween can be controlled by the head drive device accurately. Therefore the feeding of the material to be processed into the progressive die and the processing of the material to be processed can be performed steadily to thereby obtain the good processing accuracy.

In the accompanying drawings:

Fig. 1 is a diagrammatic side view of a first embodiment according to the present invention with a press machine and peripheral equipment;

Fig. 2 is a diagrammatic plane view of the first embodiment; and

Fig. 3 is a similar view to that of Fig. 2 showing a second embodiment.

The first embodiment of the present invention will now be described with reference to the attached drawings.

Fig. 1 is a diagrammatic side view showing a press machine 1 and the peripheral equipment thereof. The press machine 1 is provided with an upper die 3A as one half-member of a progressive die 3 fixed at a slider 2 which moves vertically, and a lower die 3B as the other half-member of the progressive die 3 mounted on a bolster 4. The progressive die 3 has processing portions 5-8 for a phased processing at equal pitch P, which are adapted to perform the progressive processes such as drawing, bending, punching and the like sequentially to a material to be processed 9 which is fed to the press machine 1 to form pressed products of a designated shape. The upper die 3A has plural sets of pilot pins 10A extending therefrom at equal pitch P. The upper die 3A has a set of punches 10B for making two pilot relief holes in the fed material to be processed 9 in the transverse direction thereof. The lower die 3B has thereon a set of side guides 11 at a portion where the material to be processed 9 is fed into the machine 1. The punch 10B for making two pilot relief holes is provided at a position where the interval therefrom to the nearest pilot pin 10A equals the pitch P. Half-members of the side guides 11 are provided to oppose to one another at intervals so that the material to be processed 9 passes therethrough and are formed with tapered guides 11A at an end portion of the side guides 11, respectively.

As can be seen in Fig. 1, a laser process machine 12 is disposed in front of the progressive die 3 in the press machine 1 along a feeding direction of the material to be processed. The laser processing is executed on the material to be processed 9 by means of the laser beam irradiated from a head 13 of the laser process machine 12. The head 13 is adapted to move at least in two directions in a plane that is the longitudinal direction and the transverse direction of the material to be processed 9 fed into the machine 1. A head drive device which moves the head 13 contains a control mechanism 18 having a program stored therein which makes the head 13 move in the two directions to perform the processing operations such as forming a predetermined shape of holes in the material to be processed 9 at predetermined positions. There is provided a push-roll feeding apparatus 14 with a pair of rollers 14A in front of the laser process machine 12 so that the material to be processed 9 is fed into the press machine 1 by means of the rollers 14A.

It should be understood that the material to be processed 9 is supplied from an uncoiler not shown in the drawings. The material to be processed 9 fed from the uncoiler reaches the above-mentioned laser process machine 12 through a loop controller, a leveler, and the pushroll feeding apparatus 14. Upon a forward end of the material to be processed 9 reaching the laser process machine 12, the further advancement of the material to be processed 9 is interrupted. The head 13 of

the laser process machine 12 is shifted to the stated position along the feeding direction of the material to be processed 9, whereby the forward end portion of the material to be processed 9 is cut off by the laser beam as a forward end cutting process A to obtain a fine finished forward end of the material to be processed 9 as shown in Fig. 2. The head 13 is also adapted to move diagonally in relation to the both forward corner portions of the material to be processed 9 as a forward end tapered-off process B.

Further, the head 13 moves under control in two directions to form a dummy hole 15 in the material to be processed 9. It will be understood from Fig. 2 that the dimensions of dummy hole 15 are slightly bigger than those of each processing portion 5-8 of the progressive die 3. The dummy hole 15 is formed at a position remote from the first processing portion 5 of the progressive die 3 by an integer times the pitch P in the opposite direction of the advancement of the material to be processed.

Moreover, the head 13 is moved in two directions accurately by the program to form the pilot relief hole 16 which is slightly bigger than the pilot pins 10A in the material to be processed 9. The pilot relief hole 16 is formed at a position remote from the punch B for making two pilot holes by an integer times the pitch P defined by two adjacent pilot pins 10A.

After the above process is finished, the material to be processed 9 is fed by the pitch P by means of the push-roll feeding apparatus 14, so that the process of forming the dummy hole 15 and the pilot relief hole 16 in the material to be processed 9 by the head 13 is performed whenever the material to be processed 9 is fed by pitch P. As a consequence the material to be processed 9 will have the dummy holes 15 at equal intervals to the pitch P as intervals between respective processing portions 5-8 of the progressive die 3 as well as the pilot relief holes 16 at intervals between two adjacent pilot pins 10A.

In the middle of the above-mentioned process, when the forward end 9A of the material to be processed 9 reaches to the tapered guides 11A of the side guides 11, the forward end 9A can further advance in a state guided by the side guides 11 or more specifically by the tapered portion 9B made in the forward tapered-off process B.

The process for forming the dummy holes 15 and the pilot relief holes 16 in the material to be processed 9 at regular intervals by the laser process machine 12 is repeated until the forward end 9A of the material to be processed 9 progresses to the last processing portion 8 of the progressive die 3. Even if the single operation (as the slide 2 is suspended in the up-and-down motions of the slide 2) of the press machine 1 is repeated until the forward end 9A of the material to be processed 9 progresses in the mentioned process whereas the upper die 3A of the progressive die 3 moves vertically, a loose-pressing operation occurs because the dummy holes 15 and the pilot relief holes 16 corresponding to the number of the processing portions 5-8 of the progressive die 3 are preliminarily formed in the material to be processed 9 which continuously advances and is positioned by a combination of the pilot pins 10A and the corresponding pilot relief holes 16. Accordingly, the material to be processed 9 can be fed into the press machine 1 automatically.

Especially in the present embodiment, each process such as the forward end cutting process A, the forward end tapered-off process B, the process of forming dummy holes 15, and the process of forming pilot relief holes 16 in the material to be processed 9 is performed by the laser process machine 12. These processes will solve the disadvantage of the deformation such as warpage in the material to be processed 9, or the disadvantage of the dimensional disorder of the pitch when making the pilot relief hole 16 which are the shortcomings of a cutting process or a punching process by a conventional die. Thus the material to be processed 9 can be fed to the progressive die 3 steadily and automatically.

The head 13 of the laser process machine 12 is controlled to move at least in the two directions by the program control, one being the feeding direction of the material to be processed and the other being the transverse direction of the same, so that it forms the dummy hole 15 into any complicated shape with good accuracy, if needed, and further executes the forward end cutting process A, the forward end tapered-off process, the process of forming the dummy hole 15, and the process of forming pilot relief hole 16 according to the several kinds of motions.

After the forward end 9A of the material to be processed 9 progresses until the last processing portion 8 of the progressive die 3, the process of the dummy hole 15 and the pilot relief hole 16 by the laser process machine 12 are stopped. Then, the press machine 1 begins to be driven continuously, that is the slide 2 thereof moves up and down reciprocally, feeding the material to be processed 9 by the pitch P by means of the push-roll feeding apparatus 14 in a conventional way. It should be understood that the process of forming the pilot relief holes 16 in the material to be processed 9 in this phase is performed by the punch 10B which is received on the progressive die 3.

As the main process of the material to be processed 9 by the progressive die 3 is finalized as has been mentioned above, and the predeter-

mined numbers of pressed products are produced, the feeding of the material to be processed 9 is stopped and the head 13 of the laser process machine 12 is moved in the transverse direction on the material to be processed whereby the material to be processed 9 is cut off. In a case where the necessary numbers of pressed products have not been produced from the coiled material to be processed 9, it will be naturally expected that the backward end of the material to be processed 9 and the forward end of a new supply of material to be processed are contacted with each other at the position of the laser process machine 12, so that the head 13 is further moved in the transverse direction of the material to be processed to weld the two materials to be processed to each other using the laser beam.

When the cutting process of the material to be processed 9 or the joining process of the material to be processed is complete as has been explained above, the deformation such as warpage can also be prevented because these processes are performed by the program control of the laser process machine 12. Therefore if the remainder of the material to be processed remaining at the progressive die 3 after the cutting of the material to be processed 9 is removed by a so-called remainder discharging device (not shown in the drawings), or if the longitudinally connected material to be processed is moved by the push-roll feeding apparatus 14, the remainder of the material to be processed or the connected material to be processed can be forwarded along the progressive die 3 smoothly. The accompanied processes such as the forward end cutting process A performed before the main process of the material to be processed by the progressive die 3 and the accompanied processes such as the cutting process of the material to be processed 9 required after the main process are both executed by the same laser process machine 12 so that the optionally attached devices provided with the press machine 1 can be fewer, whereby the structure can be simplified and made small in size as a whole.

The head 13 of the laser process machine 12 is moved in two directions under the control of the control mechanism 18 as has been described above, so that various shapes of hole such as the dummy hole 15 can be made in the material to be processed when applied to the different kind of pressed product, by changing the program of the control mechanism 18. Accordingly, it can be said that the device 12 has a wide application to pressed products having various profiles.

The second embodiment of the present invention is depicted in Fig. 3. In this embodiment, the press machine 1 is further provided with a pull-roll feeding apparatus 17 at the releasing side of the material to be processed. The operation which is different from the above-mentioned embodiment will be described hereinafter, and the same operation as the above embodiment will be simplified or omitted.

The material to be processed 9 which progresses until the position where the laser process machine 12 is provided by the push-roll feeding apparatus 14 will be proceeded by the forward end cutting process A and the forward end tapered-off process B as well as the process of forming the dummy holes 15 and the pilot relief holes 16 by the head 13 of the laser process machine 12. It will be observed in Fig. 3 that the interval from the forward end 9A of the material to be processed 9 obtained by the forward end cutting process A to the position where the first dummy hole 15 is made is "Q $+\alpha$" as a grip margin at the forward end 9A of the material to be processed 9 for the pull-roll feeding apparatus 17 defined by a pair of nipping rollers 17A, when the first dummy hole 15 is progressed in the last processing portion 8 in the progressive die 3, while the material to be processed 9 is repeatedly fed by the pitch P.

Following the above process, the material to be processed 9 is continuously fed by the amount of the pitch P by the push-roll feeding apparatus 14, while making the dummy hole 15 and the pilot relief hole 16 therein using the laser process machine 12. When the first dummy hole 15 is progressed at the last processing portion 8 in the progressive die 3, the forward end 9A of the material to be processed 9 reaches to the above stated position at the pull-roll feeding apparatus 17.

Then, the processes of the dummy hole 15 and the pilot relief hole 16 are not required any more, so that the press machine 1 begins to be driven continuously, while the material to be processed 9 is repeatedly forward fed by the amount of the pitch P by a combination of the push-roll feeding apparatus 14 and the pull-roll feeding apparatus 17 so as to be processed progressively.

Although, in each embodiment described above, all the forward end cutting process A, the forward end tapered-off process B, the process of forming the dummy hole 15, the process of forming the pilot relief hole 16, the cutting process of the material to be processed 9 and the joining process of the material to be processed with each other are completed together by the laser process machine 12, it will be recognized that at least one process among these processes, for example, the process of dummy hole forming may be performed by the laser process machine 12.

The accompanied processes of the material to be processed before or after the main process of the material to be processed by the progressive die are executed by the laser process machine 12,

so that problems such as deformation in the material to be processed can be prevented, whereby the material to be processed can be fed to the progressive die steadily and automatically.

The head of the laser process machine is provided to move in two directions, such as the feeding direction and the transverse direction in relation to the material to be processed, so that the process of complicated shape forming as well as the process such as the dummy hole forming corresponding to the changed products can be performed when necessary. It is also possible to perform several kinds of accompanied processes using by the same head.

## Claims

1. A method of processing a material, the method comprising a main process step of progressive processing of a material (9) which is progressively fed through a press machine (1) using a progressive die (3) which is provided in the press machine; and an accompanied process step for processing the material by a laser process machine (12) which is arranged in front of the progressive die in the feeding direction of the material.

2. A method according to claim 1, wherein the accompanied process step includes at least one process among a process (A) for cutting a forward end of the material (9), a process (B) for cutting off both corner portions (9B) of the forward end of the material (9), a process for making a pilot relief hole (16) in the material (9), and a process for making in the material a dummy hole (15) the dimensions of which are bigger than each processing portion (5-8) provided in the progressive die (3), which are performed before the main process step; and a process for cutting the material (9) and a process for joining the material (9) to a new supply of material, which are performed after the main process step.

3. A method according to claim 2, wherein the accompanied process step is to make in the material (9) a dummy hole (15), the dimensions of which are bigger than each processing portion (5-8) provided in the progressive die (3) at a position remote from the first processing portion by an integer times the pitch (P) defined between adjacent processing portions (5-8) provided at equal pitch in the progressive die along the feeding direction of the material.

4. A method according to claim 2, wherein the accompanied process step is to make pilot relief holes (16) in the material (9) at a position remote from a punch (10B) making pilot relief holes, at a portion where the material to be processed is fed into the progressive die (3), by an integer times the pitch (P) defined between pilot pins (10A) and the punch (10B) provided at equal pitch in the progressive die along the feeding direction of the material.

5. An apparatus for progressively processing a material, comprising a press machine (1) having a progressive die (3) for processing material (9) which is fed into the press machine; a laser process machine (12) which is disposed in front of the progressive die (3) in the feeding direction of the material, the laser process machine being provided with a head (13) for irradiating a laser beam which processes the material, the head being adapted to move at least in two directions.

6. An apparatus according to claim 5, wherein a drive device for moving the head (13) in the two directions contains a control mechanism having a program for controlling the head.

7. An apparatus according to claim 5 or claim 6, wherein the head (13) is adapted to move in the feeding direction of the material and in a transverse direction.

FIG. 1

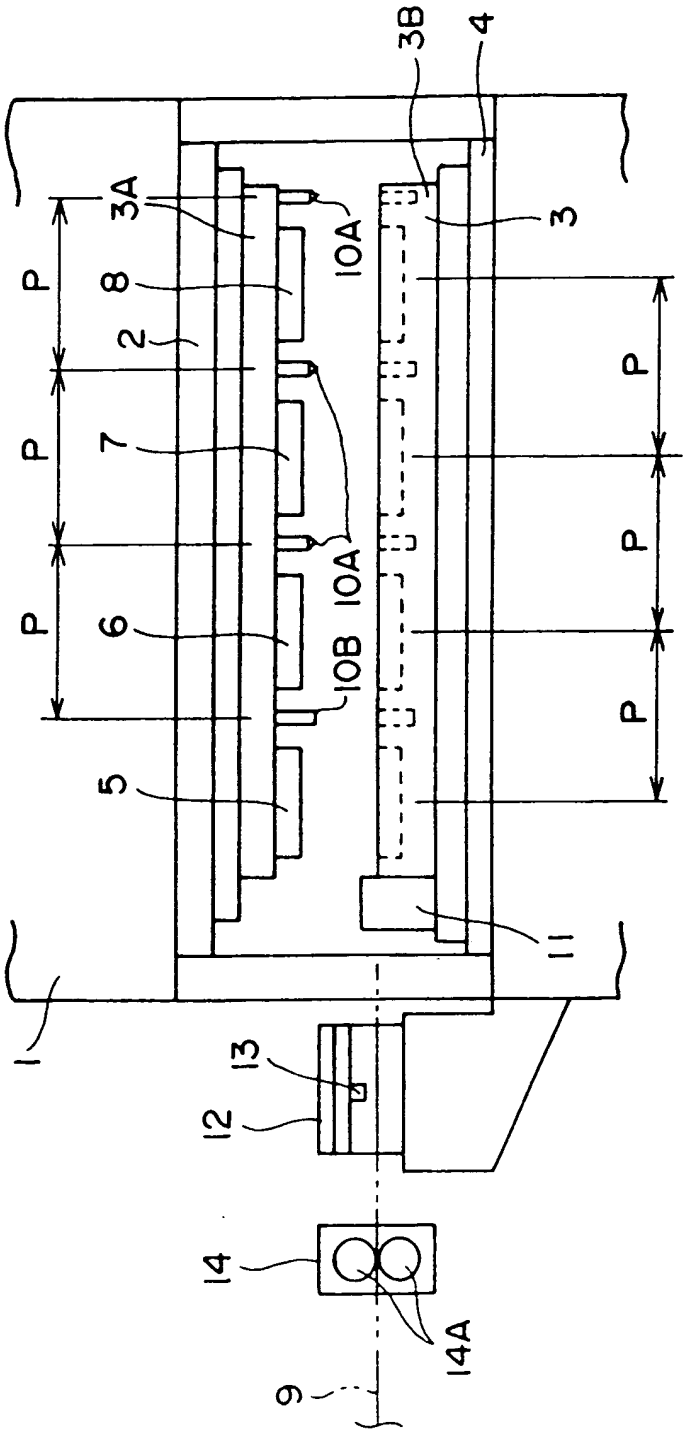


FIG.2

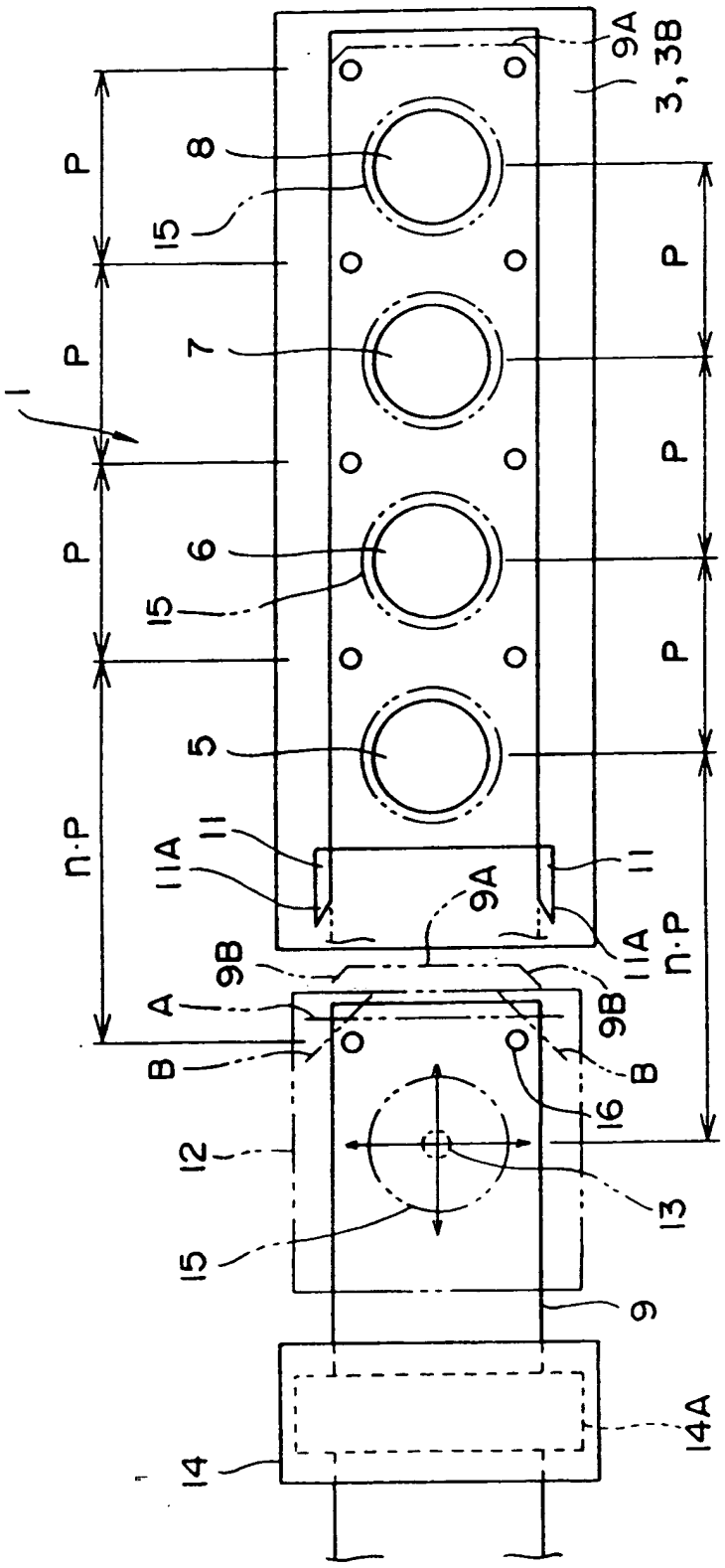
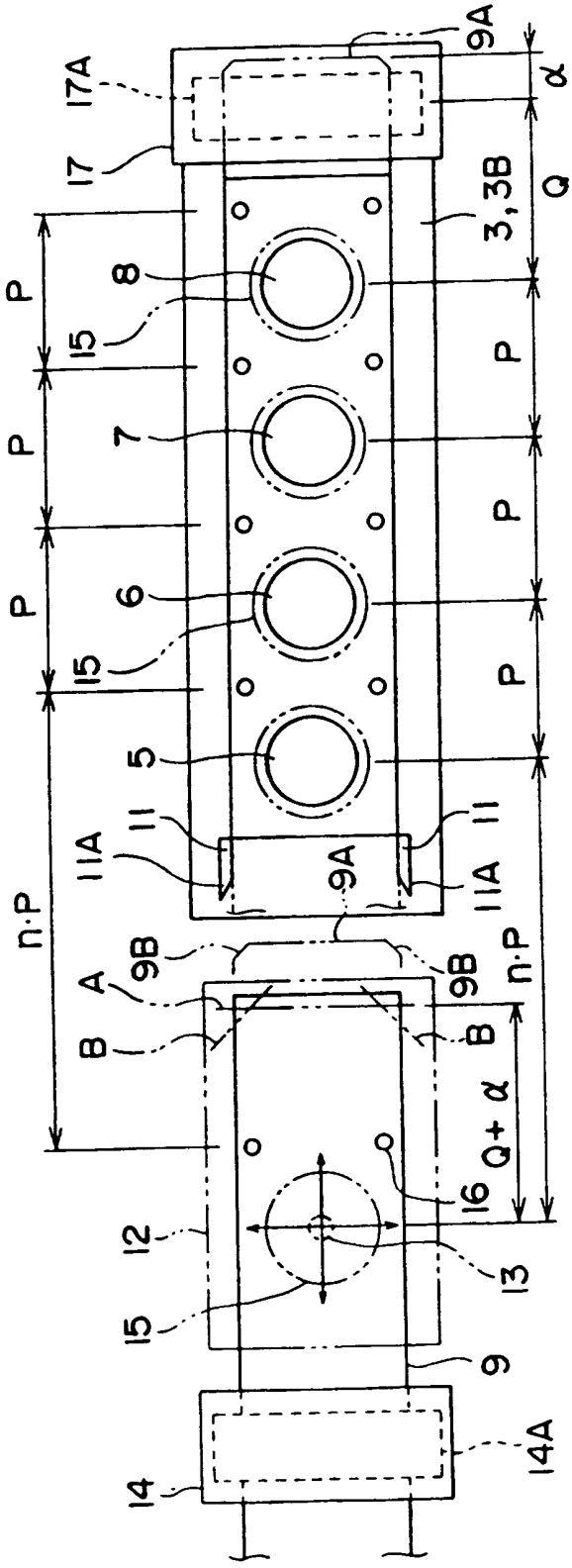


FIG. 3



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# EUROPEAN SEARCH REPORT

Application Number
EP 94 30 0261

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int.Cl.5) |
|---|---|---|---|
| Y | PATENT ABSTRACTS OF JAPAN vol. 14, no. 177 (M-960) (4120) 9 April 1990 & JP-A-02 030 333 (AMADA CO LTD) 31 January 1990 * abstract * | 5-7 | B21D43/05 B21D37/08 |
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| | --- | | TECHNICAL FIELDS SEARCHED (Int.Cl.5) |
| A | FR-A-2 556 262 (RESSENCOURT) | | B21D |
| | --- | | |

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 9 June 1994 | Gerard, O |

CATEGORY OF CITED DOCUMENTS

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